

USPTO Technical Reference Model Case Study

U.S. Department of Commerce Patent Trademark Office

Introduction

The United States Patent and Trademark Office (USPTO) is one of 14 agencies within the Department of Commerce (DoC). USPTO's mission is derived from the U.S. Constitution, which states, "The Congress shall have the power to promote the progress of science and the useful arts, by securing for limited times to inventors exclusive rights to their discoveries." The USPTO enterprise includes six business areas: Patents, Trademarks, Information Dissemination, Corporate Support Function, Policy Function, and Infrastructure. The primary services USPTO provides include examining and issuing patents, examining and registering trademarks, and disseminating patent and trademark information to promote an understanding of intellectual property protection and facilitate development and sharing of new technologies worldwide.

To successfully carry out its mission, USPTO is supported by an array of automated information systems (AISs) and a robust underlying information technology (IT) infrastructure. USPTO's current inventory lists approximately 44,000 commercial off-the-shelf (COTS) hardware assets and 780 COTS software products. The backbone of the current IT infrastructure is a high-speed switched network that links several hundred UNIX and Windows NT Servers, more than 8,000 Windows NT desktop workstations, 140 high-speed shared printers, and in excess of 70 terabytes of on-line magnetic mass storage.

Under the Office of the Chief Information Officer (OCIO), USPTO centralizes the responsibility for IT planning, technical direction, oversight, policy formulation, system development and acquisition, day-to-day operational management of the IT infrastructure, and dissemination of IT products and services. To provide a firm foundation for carrying out these duties, OCIO has instituted a comprehensive IT Architecture Management Framework and an enterprise Technical Reference Model (TRM).

Purpose/Objective

The remainder of this document presents a case study of USPTO's implementation of its IT Architecture Management Framework and TRM. Section 3 explains the rationale and objectives for implementation. Section 4 provides insight into USPTO's methodology and approach. Section 5 quantifies the effectiveness of the USPTO IT Management Framework and TRM in meeting objectives. Section 6 summarizes lessons learned by USPTO, as well as future plans. Sections 7 and 8 provide a list of references and acronyms, respectively.

Rationale

As it evolved over the years, USPTO's IT infrastructure came to comprise a collection of heterogeneous computing and communications hardware and often incompatible COTS software products. IT tended to be managed on a piecemeal basis, with the IT infrastructure managed as a set of distinct application systems, each with its own dedicated operations and support organization. This environment constrained USPTO's ability to readily comply with new Federal

laws and regulations for IT, rapidly incorporate and leverage new technologies to meet evolving requirements, and carry out its mission in the most cost-effective manner.

Recognizing these shortcomings, USPTO began in early 1994 to aggressively address its IT infrastructure problems and to better prepare itself for the challenges of the future. USPTO developed an ambitious strategic agenda to modernize and to migrate its IT infrastructure to a standards-based, open system environment that would help position it to operate more successfully and efficiently in the 21st century. USPTO's strategic agenda is focused on providing an IT environment for itself, its international partners, and the public where patent and trademark information is created once, managed effectively, used often, and evolved over time to electronic commerce whereby most transactions are performed electronically using the Internet.

USPTO decided that an enterprise-wide management approach to the IT architecture would be the most effective for satisfying strategic business area goals and meeting day-to-day operational requirements. USPTO began to formulate and implement an IT Architecture Management Framework designed to meet the key goals shown in Figure 1. Implemented effectively, this framework will ultimately lead to reductions in patent and trademark cycle times, elimination of paper-based processing, and evolution of the businesses to electronic commerce and an electronic workplace.

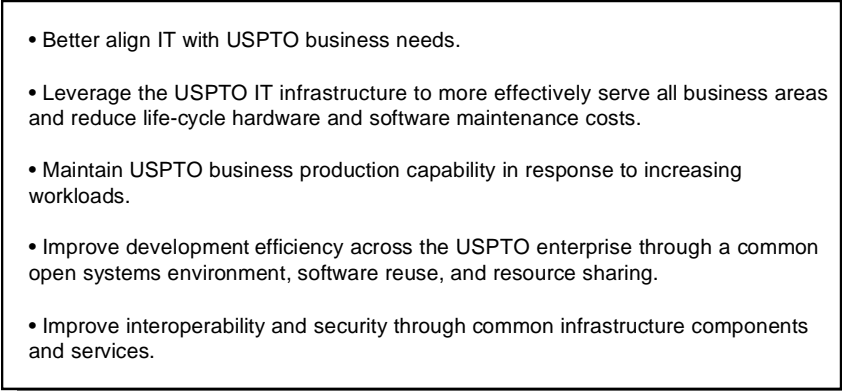
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- Better align IT with USPTO business needs.
 - Leverage the USPTO IT infrastructure to more effectively serve all business areas and reduce life-cycle hardware and software maintenance costs.
 - Maintain USPTO business production capability in response to increasing workloads.
 - Improve development efficiency across the USPTO enterprise through a common open systems environment, software reuse, and resource sharing.
 - Improve interoperability and security through common infrastructure components and services.

Figure 1. Key Goals of USPTO IT Architecture Management Framework

Description

USPTO's IT Architecture Management Framework, illustrated in Figure 2, is consistent with the Federal Enterprise Architecture Framework endorsed by the Chief Information Officers Council as a road map for achieving better alignment of technology solutions with business mission needs.

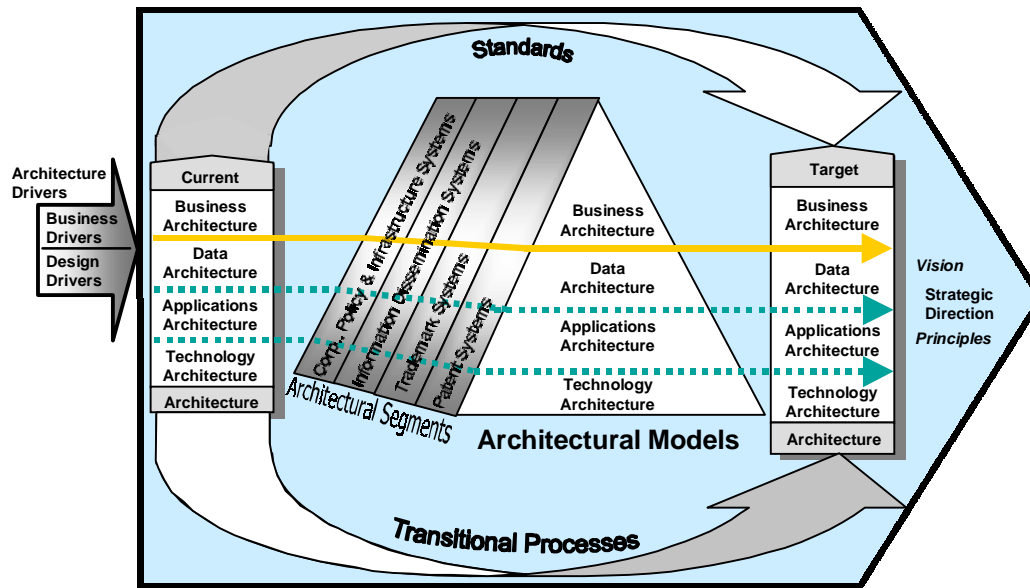


Figure 2. USPTO IT Architecture Framework

As shown in Figure 2, the USPTO framework provides the foundation for maintaining and evolving the Current ("As-Is") USPTO Architecture to the Target ("To-Be") Architecture needed to satisfy USPTO's strategic direction and business goals. The framework relates:

- The external drivers, or stimuli, that cause the architecture to change
- The business functions performed in all six business areas (segments)
- The data needed to perform the business functions
- The applications needed to capture and manipulate the data
- The infrastructure technology (hardware, networks, and communication devices) needed to run the applications
- The set of standards, voluntary guidelines, and best practices in use
- The models, plans, policies, governing strategies, and other documentation used as the basis for managing and implementing changes in the architecture
- The processes that support transition from the Current to the Target Architecture
- The strategic direction guiding development of the Target Architecture.

Additionally, the framework supports OCIO in ensuring that all USPTO IT initiatives:

- Are managed in accordance with USPTO life cycle management (LCM) principles and practices. Application of these principles and practices helps deliver quality systems that meet or exceed customer expectations, work effectively and efficiently within the current and planned IT infrastructure, and are more cost-effective to maintain and enhance.
- Are consistent with USPTO's Strategic Information Technology Plan (SITP). The SITP provides important information on USPTO's strategic vision for implementing an

electronic workplace, as well as its associated management strategies, planning assumptions and constraints, decision making processes, and priorities.

- Adhere to current and planned IT standards and products contained in USPTO's TRM. The TRM provides a comprehensive set of IT services, standards, and preferred products and is used for the acquisition, development, and support of all USPTO AISs and the underlying IT infrastructure. Because it is explicitly tailored to the USPTO enterprise and contains additional elements such as the standards profile and preferred products, the USPTO TRM is a more encompassing document than the DoD TRM. The DoD TRM document is intended only to provide a description of the DoD's Technical Reference Model. Its scope is necessarily broader so as to accommodate a wider range of requirements and system configurations.

Figure 3 illustrates USPTO's IT Management process. As shown, the USPTO Corporate Performance Plan and the Strategic IT Plan drive the process. Figure 3 also emphasizes the critical role the TRM plays within USPTO's IT Architecture Management Framework. By guiding and coordinating IT infrastructure acquisitions, AIS development and deployment, operations, and support across the USPTO business areas, the TRM promotes open system design.

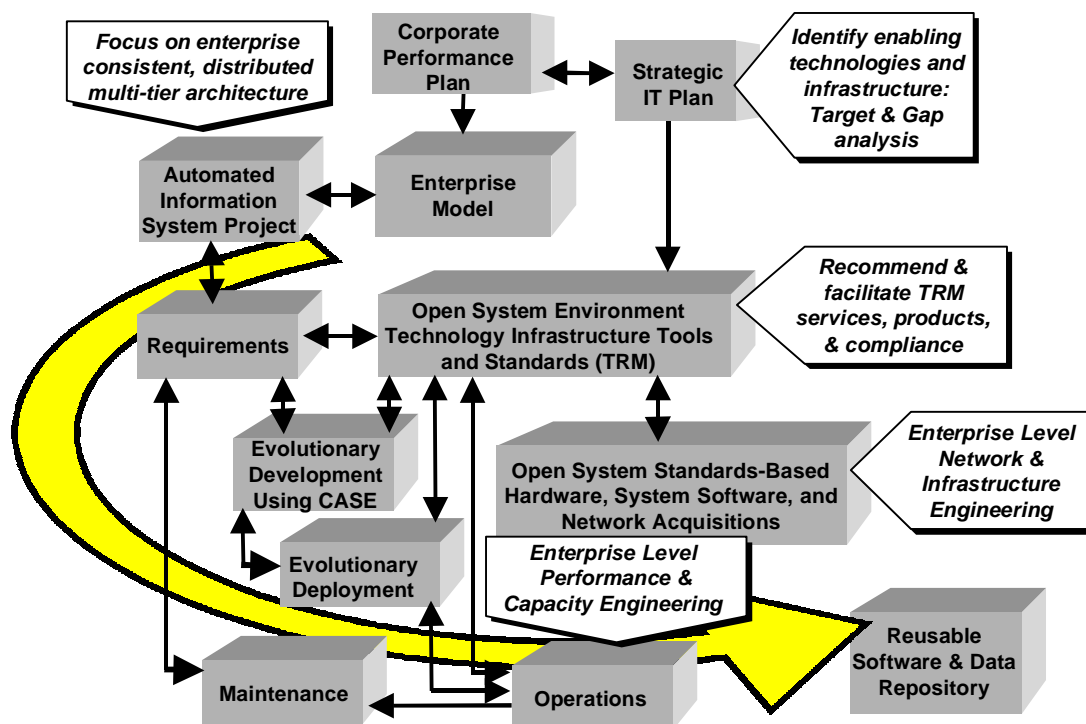


Figure 3. USPTO IT Management Process

The structure of the USPTO TRM is shown in Figure 4. The TRM includes a broad set of service areas and interface relationships that are used to increase interoperability and compatibility across USPTO systems and promote software reuse.

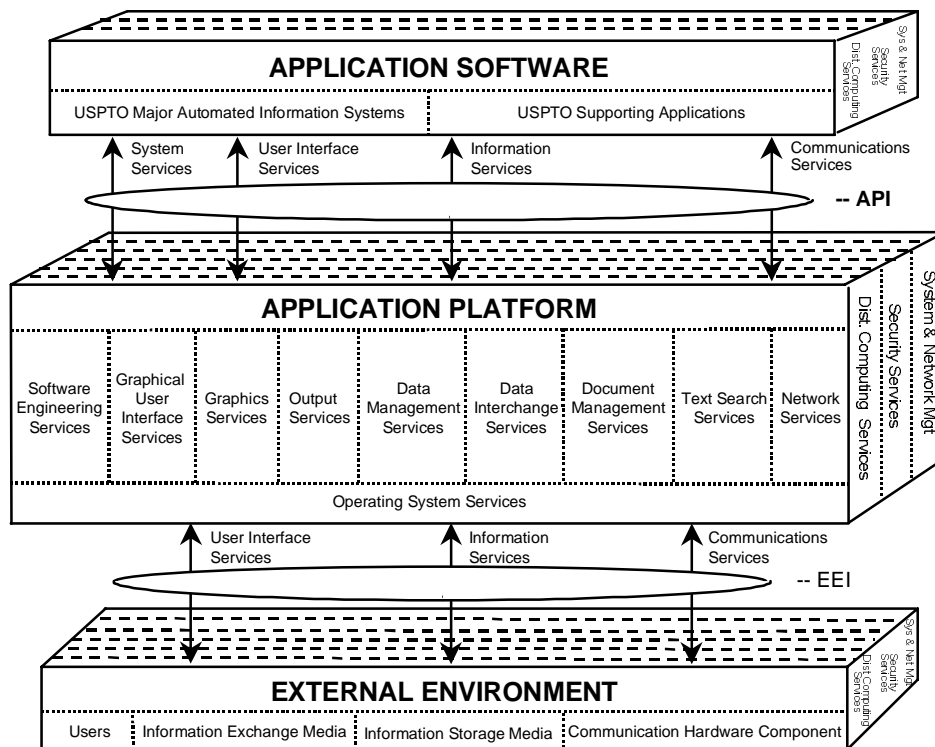


Figure 4. USPTO TRM Service Areas

The first version of the USPTO TRM was published in November 1995. It was based on open system standards identified in the Department of Defense (DoD) Technical Architecture Framework for Information Management (TAFIM) and the National Institute of Standards and Technology (NIST) Application Portability Profile (APP), as well as de facto industry standards. Further tailoring was performed to include service areas, standards, and products needed to meet USPTO-unique requirements, in particular, for Document Management and Full-Text Search.

The USPTO TRM is an evolving entity that is maintained throughout each year and republished annually. The strategic direction reflected in the TRM is formally established by the CIO and is subject to Technical Review Board (TRB) and Software Engineering Process Group (SEPG) approvals. Transition from the Current to the Target Architecture is supported by revising and adding new service areas, standards, and products to the TRM. The USPTO SITP is used to establish the priorities for TRM service areas needed to support mission-critical business system development.

Results/Findings

Through implementation of the IT Management Framework and TRM, USPTO has made measurable progress towards the objectives shown in Figure 1. A full and complete discussion of results is provided in the USPTO publication, *Business Case: Managed Information Technology Infrastructure*. Among the important benefits realized by USPTO are:

- An improved blueprint for managing the evolution of IT in response to changing business needs

- More cost-effective IT-related expenditures due to standardization and an improved understanding of the relationship of IT to USPTO strategic and business goals
- Enhanced information flow through the USPTO enterprise and with external customers and organizations
- A proven foundation to help meet future IT challenges faced by USPTO, such as security, e-commerce, 24x7 operations, and on-line backup and recovery.

USPTO studies have quantified significant economic benefits. Between fiscal year (FY) 1996 and FY 2000, USPTO achieved a "one-time" savings of \$31.7 million and recurring annual savings of approximately \$32.1 million. Cost savings have been achieved due to a range of factors, including migration to a common open system environment with common infrastructure components and services, better management of the life cycle of hardware and software, improved user productivity, and reduced IT training requirements. The number of brands of desktop workstations, for example, has been reduced from 300 to less than 10, resulting in cost savings for both procurement and maintenance.

USPTO also has a significantly lower Total Cost of Ownership (TCO) for Desktop Workstations as compared to industry average. USPTO's five-year TCO for Desktop Workstations is just under \$32,000. A November 1998 Gartner Group study found that the five-year Desktop Workstation TCO for private industry was \$44,250.

Moreover, as illustrated in Figure 5, USPTO's improved understanding of the relationship of IT to business goals has allowed USPTO to maintain business production capabilities in response to increasing workloads. Note the significant increases in IT Workload and Search Data Base size accommodated by relatively small proportional increases in IT investment.

Between FY 1996 and FY 2000, USPTO experienced a 90 percent increase in patent image searching, 81 percent increase in patent/trademark text searching, and a three-fold increase in the size of patent/trademark search databases. Over the period FY 1996–99, USPTO also experienced a 70 percent increase in patent/trademark business transaction processing. These significant increases have been accommodated by stable IT investment expenditures.

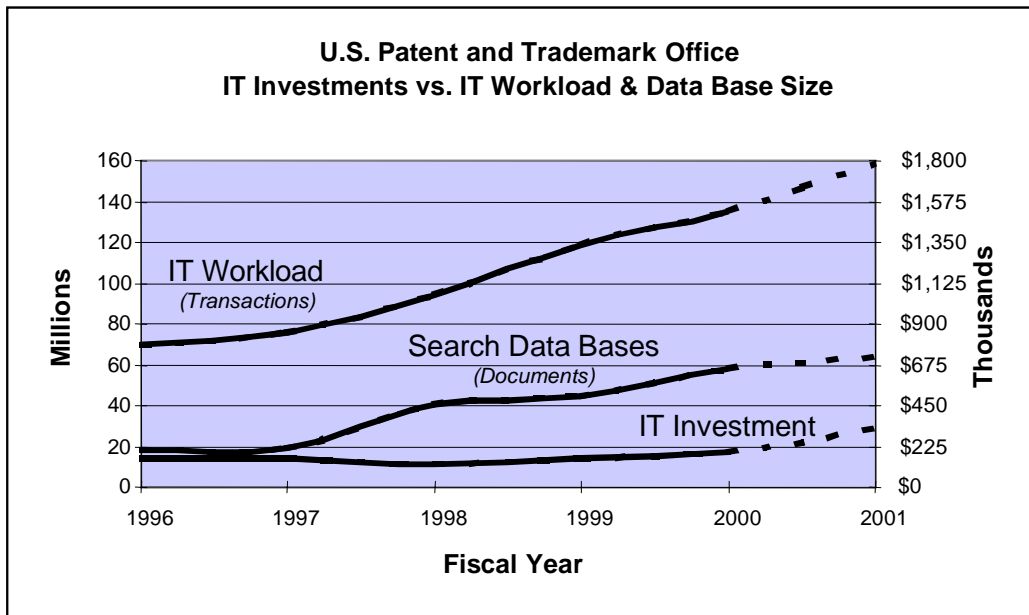


Figure 5. USPTO IT Investments vs. IT Workload and Data Base Size

USPTO has also improved development efficiency through reuse of software components and designs, resource sharing, and the promulgation of standard data elements. According to USPTO studies, four AISs alone—Order Entry Management System (OEMS), Patent Application Location and Monitoring (PALM), Patent Cooperation Treaty Operations Workflow and Electronic Review (POWER), and Trademark Reporting and Monitoring, Advanced (TRAM++)—together used 291 standard data elements, thereby saving a total of more than \$90,000 in development costs.

Finally, the TRM has improved interoperability of USPTO systems by creating stable, directed technical environments that allow standards and processes to be defined and applied effectively and then quickly automated. For example, templates of messaging and security components were developed and subsequently used in the implementation of multiple AISs. Interoperability was achieved through business-level infrastructure components. The components represent a one-time development effort that can be reused. Subsequent systems merely interface to the components. As these components continue to be reused, redundant legacy data stores can be retired, along with the complex mapping and interfacing software that is now used to keep the data stores synchronized.

Conclusions

As the results and findings presented in Section 5 clearly demonstrate, USPTO's IT Management Framework and TRM have proven very effective in meeting objectives and providing a mechanism for IT governance. However, USPTO learned several valuable lessons during this process and is developing strategies and approaches to make the IT Management Framework and TRM even more effective.

Organizational Responsibilities

Teamwork is essential to delivering quality systems on time and within budget. USPTO's paradigm features close coordination and partnership between the business areas and OCIO. Each business area identifies and prioritizes "what needs to be done" in terms of business functions and performance goals. OCIO identifies how IT can be applied to help the business area achieve results while maintaining efficient and effective IT operations throughout USPTO. At USPTO the OCIO organization includes divisions responsible for developing High-Level Architectures; reviewing AIS technical designs; evolving the architecture for the USPTO-wide IT infrastructure; and evaluating and incorporating emerging technologies, standards, and products into the USPTO TRM.

TRM Evolution

Because of the rapid rate of technological change and advancement, the TRM will not always have standards and products defined in advance. It must evolve. In the areas of security and Web technologies, for example, innovative new strategies and products regularly emerge. In the past at USPTO, standards and products selection in these rapidly changing areas was influenced more by the particular individual system that happened to "get there first" than by an enterprise-wide assessment. This resulted in inconsistencies and selections that, in retrospect, may not have been optimal.

To address this, OCIO has established Technology Working Groups (TWGs) to focus on specific emerging and enabling technology areas of importance to USPTO (e.g., Security, Web, Middleware, and Backup and Recovery). TWG members are Subject Matter Experts (SMEs) from across the enterprise, who provide input on strategic direction and make specific TRM recommendations regarding service areas, standards, and products.

IT Architecture Information Dissemination

It is more important than ever that all employees within an enterprise gain a better understanding of the enterprise IT Architecture and the critical relationship of IT to strategic and business goals. USPTO provides training on the role of the IT Architecture for developers and managers. To provide a conveniently accessible mechanism for promulgating this information, OCIO also deployed a Web site that presents the USPTO IT Architecture in the context of the Federal Enterprise Architecture Framework.

Starting at the top level of the framework, shown in Figure 2, users can "drill down" to more detailed information on the business, data, applications, and technology infrastructure components of the USPTO IT Architecture. The Web site has been operational on the USPTO Intranet since early 2000. In late 2000 OCIO deployed an Internet version of the USPTO IT Architecture Web site that is accessible to the general public (URL: <http://www.uspto.gov/web/offices/cio/osa/sad/ita/index.html>). To make this mechanism even more effective and useful, OCIO plans to increase the breadth of IT Architecture information available via the Web and to comply with new Federal requirements (known as "Section 508") to make USPTO web pages more accessible to people with disabilities.

IT Architecture Maturity

In recognition of the importance of effectively implementing IT Architectures, DoC recently introduced a methodology for assessing the IT processes used by its agencies. This methodology, known as the Department of Commerce IT Architecture Capability Maturity Model (CMM), is an aid for conducting such assessments. The CMM is used to spotlight processes requiring improvement and provide a defined path toward that improvement. The DoC IT Architecture CMM includes six levels ranging from 0 (No IT Architecture Program) to 5 (Optimizing – Continuous Improvement of the IT Architecture Process). USPTO will continue to actively support DoC IT initiatives, such as the IT Architecture CMM, and strive to continuously improve its IT Architecture processes.

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Acronyms

AIS	Automated Information System
API	Application Program Interface
APP	Application Portability Profile
CIO	Chief Information Officer
CMM	Capability Maturity Model
COTS	Commercial-Off-the-Shelf
DoC	Department of Commerce
DoD	Department of Defense
EEI	External Environment Interface
FY	Fiscal Year
IT	Information Technology
LCM	Life Cycle Management
NIST	National Institute of Standards and Technology
OCIO	Office of the Chief Information Officer
OEMS	Order Entry Management System
PALM	Patent Application Location and Monitoring
POWER	Patent Cooperation Treaty Operations Workflow and Electronic Review
SEPG	Software Engineering Process Group
SITP	Strategic Information Technology Plan
SME	Subject Matter Expert
TAFIM	Technical Architecture Framework for Information Management